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14D Natural Geohazards

National Grid (Richborough Connection Project) Order

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Richborough Connection Project

Volume 5

5.4 Environmental Statement Appendices

5.4.14D Natural Geohazards

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Table of Contents

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1. INTRODUCTION

1.1.1 This technical appendix supports **Volume 5, Document 5.2, Chapter 14 Geology, Soils and Agriculture**. The scope of ground instability effects requiring assessment in the Environmental Statement (ES) specifically excludes risks associated with the bearing capacity of the ground (other than specific abnormal issues such as the presence of landfill deposits). This approach has been formally agreed with the Planning Inspectorate in advance of the preparation of the ES, within paragraph 3.10 of the Scoping Opinion.

1.1.2 The effects that have been scoped out of the ES include collapsible ground, compressible ground, ground dissolution, landslides, running sand and shrinking / swelling clays. Managing and preventing these hazards is a routine engineering consideration and therefore does not warrant detailed assessment within the ES. Nevertheless, several of these issues are important considerations in construction design for the proposed development. Accordingly, the purpose of this appendix is to provide a brief overview of the engineering challenges associated with these natural geohazards within the Order limits, and how these will be addressed by engineering design and construction methods.

1.1.3 The primary data source used in the preparation of this appendix is British Geological Survey (BGS) hazard mapping, obtained via Landmark Information Group Ltd.

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2. LANDSLIDE HAZARD

2.1.1 Landslides are mass-movements of rock, earth and debris down slope, under the force of gravity, and can take several kinematic forms. The damage caused by a landslide is very much dependant on its speed, location and proximity to people and structures[1].

2.1.2 A landslide will occur if the force of gravity acting on a slope exceeds the strength of the material forming the slope. External factors, such as weather conditions, can result in the reduction or increase of the strength of the slope, while the triggering mechanisms for landslides are varied, comprising both natural (e.g. rainfall, snow melt or inherent structural or lithological weakness) and anthropogenic factors (e.g. oversteepening of the slope, loading of the slope, or the removal of material from the toe of the slope).

2.1.3 The BGS holds information both on historical landslide events and areas of potential future ground movement. Using this information, the BGS has created a Landslide Hazard grading system, ranking the potential for future landslides. The topography in the west of the Order limits (Sections A & B) varies from flat lying to undulating, whilst that in the east (particularly Section D) is flat lying. The landslide hazard potential correlates with this, being classified as ‘very low’ / ‘low’ in Sections A & B and ‘no hazard’ / ‘very low’ in Sections C & D. The vast majority of the Order limits falls into the ‘very low’ hazard potential category.

Construction Methods

2.1.4 The Order limits is not considered to be at risk from landslide hazards and specialist construction techniques to address landslide hazard are not anticipated to be necessary. However, hazard mapping is generic and the presence of localised minor slopes cannot be discounted. In the unlikely event that any such slopes cannot be avoided by micro-siting within the Limits of Deviation, then construction should avoid additional loading at the top of the slope or removal of material from the toe, where possible, together with localised stabilisation works if necessary.

[1] British Geological Survey ‘UK Geohazard Note: Landslides’, May 2012.

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3. POTENTIAL FOR COLLAPSIBLE GROUND STABILITY HAZARDS

3.1.1 Certain types of ground may contain layers that are prone to undergo a sudden and permanent reduction in volume (collapse)[2]. Collapsible soils include loess and brickearth, the latter of which occurs relatively extensively within the Order limits. The cause of collapse is a product of the microscopic structure of the soils. In collapsible soils, this structure is very open and contains a large void volume. This open structure is reliant on the cohesion of clay sized particles that coat sand and silt grains, bonding them together. The result is a structure that can remain stable under a considerable thickness of overlying deposits but, upon becoming saturated with water or being subjected to an additional load, can reduce rapidly in volume, causing differential settlement / collapse.

3.1.2 This effect does not tend to occur as one event when a building or infrastructure is constructed on collapsible deposits that are already saturated, as in these circumstances settlement tends to occur as loading increases during foundation construction, so that by the time the building or infrastructure is complete, the majority of settlement has already been experienced. Problems arise when buildings or infrastructure are constructed on relatively strong, partially saturated deposits that become weakened by subsequent saturation. Saturation may occur through changes in the local water table or events such as leakage from underground pipes.

3.1.3 The potential for collapsible ground hazards (i.e. the likely presence of collapsible ground) can be broadly split into two areas. Sections A & B (Stour Valley and Sarre Penn Valley) are classified by the BGS as having a very low or moderate hazard potential, with a narrow corridor around Chislet where there is considered to be no hazard. The areas displaying a moderate hazard potential correlate with superficial deposits of Head (which are generally synonymous in this instance with brickearth). Sections C & D (Chislet Marshes and Ash Levels) are generally recorded to have no hazard, apart from a small area around Wall End Farm and an area to the south of Gore Street, which have very low to moderate hazard potential, with the moderate hazard potential again associated with Head deposits.

Construction Methods

3.1.4 The proposed development includes the construction of new pylons and associated development on deposits of Head. Due to the very specific conditions required to trigger the hazard, namely the significant input of water into the deposits, it is not considered that any of the proposed construction activities will cause the hazard to be realised. Construction works would not be expected to materially change the standing groundwater level or saturation state of the Head deposits, other than temporarily, minimising the risk for post-construction ground collapse. To assist in minimising the risk, surface drainage will be controlled during construction to minimise the potential for additional saturation of soils. Any dewatering required (e.g. in foundation excavations) will be undertaken in a controlled manner.

3.1.5 Notwithstanding this, to provide additional protection against this hazard, any collapsible deposits present a very shallow depth will be removed by excavation prior to construction, where the deposits are sufficiently thin for this to be practicable.

[2] British Geological Survey 'UK Geohazard Note: Collapsible Ground', June 2014.

Where deposits are too thick for this to be the case, pre-construction engineering investigations / calculations will allow for an estimation of the collapsible ground hazard and associated maximum potential settlement, to ensure that any settlement associated with additional loading during foundation construction is controlled and does not affect infrastructure or land.

4. POTENTIAL FOR COMPRESSIBLE GROUND STABILITY HAZARDS

4.1.1 Many natural soils contain water-filled pores. The soils are considered to be compressible if an applied load causes the water in the pore space to be squeezed out, resulting in a volume reduction. Peat, alluvium, laminated clays, some silts and sands, and Made Ground are types of deposit commonly associated with various degrees of compressibility. This deformation of the ground is normally an irreversible process that occurs either during or after the application of an increased load (e.g. construction). Compressible materials undergo both primary and secondary settlement. Primary settlement takes place in days and occurs due to water expulsion during loading, whilst secondary settlement may last years and is due to the subsequent restructuring of the material[3].

4.1.2 The effects of ground compression can include the direct subsidence of structures and / or damage due to differential ground settlement (in ground that is not uniformly compressible), which may include tilting, cracking or distortion. In addition to direct compression of the ground, construction on saturated compressible deposits can cause the loss of pore water, resulting in a volume reduction of the deposits, leading to settlement and corresponding damage to buildings and infrastructure.

4.1.3 As with collapsible ground, the potential compressible ground hazards can broadly be split into two areas. Sections A & B are mainly areas where there is no hazard potential, apart from areas of alluvium to the north of Upstreet, which the BGS classifies as having a moderate hazard potential. Sections C & D are mainly areas where there is moderate hazard potential, apart from the area to the south west of Monkton, which the BGS classifies as ‘no hazard’. The moderate hazard potential areas correlate with areas of alluvium (in Sections A & B) and the extensive low lying tidal flat deposits in Sections C and D, which include significant thicknesses of silt and clay with high standing groundwater levels.

Construction Methods

4.1.4 Compressible ground is a common construction challenge in the UK, both in low lying coastal regions (such as Sections C & D) and peat uplands. As a result of this, there are many tried and tested design and construction techniques for dealing with compressible ground hazards. Specific techniques that may be applied to the Richborough Connection Project will be the use of piled foundations (i.e. driven steel piles or concrete augered piles) to ensure that pylons are founded on suitable non-compressible strata, and the utilization of “floating roads” for access tracks (with geogrid and stone sub-base). There is no anticipated net increase in loading associated with the installation and presence of 11 kV / 33 kV underground cable ducts, such that ground compression is not considered to present a risk.

4.1.5 Dewatering of compressible deposits will be avoided where possible. This can be achieved by the use of standard construction techniques; one such method is piled foundations. However, given the nature of the proposed development and the ground conditions, it is inevitable that dewatering will be required in some instances. In these circumstances, the potential for damaging settlement will be prevented by the use of

[3] British Geological Survey ‘UK Geohazard Note: Compressible Ground’. June 2014

appropriate techniques (such as proof rolling of the formation level) prior to construction.

4.1.6 Shallow trenches in locations where undergrounding of 33 kV / 11kV cables is required are unlikely to need sufficient dewatering to affect ground stability. Furthermore, in the unlikely event that they are necessary, suitable construction methods exist that would minimise the requirement for dewatering. One such method is directional drilling, although other methods are available

5. POTENTIAL FOR GROUND DISSOLUTION HAZARDS

5.1.1 Soluble rocks can dissolve leading to the formation of caves and cavities that may eventually collapse, consuming overlying materials and causing subsidence at the surface. The collapse mechanism can be natural or man-made, and a major trigger is infiltration of water, often from extended periods of heavy rainfall, burst pipes or leaking drains. In addition, dissolution can also cause poor ground conditions and engineering problems[4].

5.1.2 There are five main soluble rock types found in Great Britain. These are dolomite, limestone, chalk, gypsum and halite. The only one of these rock types to occur within the Order limits is chalk, which sub-crops in a small area to the south west of Monkton. The BGS classifies the ground dissolution hazard potential in this location as 'very low'. The only activities associated with the proposed development in this location are the dismantling of existing 132 kV infrastructure (removal of foundations to 1.5m below ground level).

Construction Methods

5.1.3 Due to the recorded hazard potential within the Order limits, and the nature of the proposed activities within the very low hazard potential area, it is considered that no specialist construction techniques will be required in relation to ground dissolution hazards.

[4] British Geological Survey 'UK Geohazard Note: Soluble Rocks' March 2014

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6. POTENTIAL FOR RUNNING SAND GROUND STABILITY HAZARDS

6.1.1 Loosely-packed sand can become fluidized by the presence of flowing groundwater. Such sands can 'run', removing support from overlying buildings and causing potential damage.

6.1.2 Running sand hazards can occur where excavations in susceptible sand deposits go below the water table, where springs occur at the base of sand outcrops, or around leaking drains or mains water supply pipes.

6.1.3 Consequences associated with running sands may include damage to underground services and foundations.

6.1.4 The Order limits can broadly be split into two areas in relation to hazards associated with running sands. Section A & B have either no hazard or a low hazard potential, while Sections C & D generally have a moderate hazard potential, apart from the area to the south west of Monkton, which has no hazard potential. The moderate running sand hazard potential in Sections C & D is associated with the tidal flat deposits in this area.

Construction Methods

6.1.5 The primary means of preventing damage due to running sand hazards is the avoidance of excavations below the water table. Construction methods within the moderate hazard potential zone will be designed based on this premise wherever possible. Appropriate methods are likely to include the use of piled foundations for new pylons.

6.1.6 Any consideration of shallow excavations within the moderate hazard potential zone will be informed by pre-construction investigations to ensure that groundwater levels are characterised in advance. It is not anticipated that pad and chimney foundations for pylon bases will be used where shallow groundwater is present within the moderate hazard potential area, due to the volume of water needed to be extracted to adequately dewater the excavation. Instead, driven piles or augered piles are recommended, which will effectively negate any concerns with running sand hazards.

6.1.7 Small scale excavations below the water table may be unavoidable in some cases. In these instances, it is considered that temporary dewatering and trench support will be able to maintain adequate excavation stability and prevent running sand hazards.

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7. POTENTIAL FOR SHRINKING OR SWELLING CLAY GROUND STABILITY HAZARDS

7.1.1 Shrink-swell occurs as a result of changes in the moisture content of clay-rich soils. This is reflected in a change in volume of the ground through shrinking or swelling. Swelling pressures can cause heaving of structures, while shrinking can cause settlement[5].

7.1.2 Damage to structures may occur when the volume change of the soil, due to shrinking or swelling, is unevenly distributed beneath the foundations. This can lead to one corner or wall parts of a building rising or falling, relative to the remainder.

7.1.3 The amount by which the ground can shrink and/or swell is determined by the water content in the near-surface soil, and the type of clay. Fine-grained, clay-rich soils can absorb large quantities of water after extended periods of heavy rainfall. Conversely, during extended periods of low rainfall, these soils can shrink[5].

7.1.4 Section A and the western half of Section B have a moderate shrink / swell hazard potential, whilst the eastern half of Section B and Section C & D generally have either no or very low hazard potential. The moderate hazard potential associated with Section A and the western half of Section B is a consequence of the presence of London Clay deposits.

Construction Methods

7.1.5 London Clay deposits are present across large parts of south eastern England, particularly in London and Essex. The engineering challenges associated with their shrink/swell potential are routinely encountered and dealt with during engineering design and construction. Geotechnical characterisation of the deposits will be undertaken to inform the detailed engineering design. This will also consider the presence of trees, to account for the effects of tree roots on the moisture content of soils. The proposed foundation construction methods for the project include methods capable of preventing the effects of shrinking / swelling on new pylons (e.g. use of piled foundations). Standard methods for preventing the effects of shrink / swell clays on underground cables (such as the proposed 33 kV / 11kV underground sections) include the placement of infrastructure below the depth of seasonal drying.

[5] British Geological Survey 'UK Geohazard Note: Ground Shrinking and Swelling', May 2012.

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